

# PM<sub>10</sub> Modeling Protocol Summary

Modeling tools have advanced in the years between the development of the current PM<sub>10</sub> SIP in the late 1980's and today. The existing SIP is based on receptor modeling and county-wide roll-back of PM<sub>10</sub>, SO<sub>2</sub>, and NO<sub>x</sub>. In consultation with EPA Region VIII, DAQ has decided to base the attainment demonstration for this new SIP/Maintenance Plan on a grid-based aerosol modeling approach using UAM-AERO which will be corroborated by an independent speciated linear rollback. The attainment/maintenance demonstration would be based on the results of one or both of these models.

UAM-AERO, an urban-scale grid-based aerosol model developed by the California Air Resources Board will be used to analyze the airshed for one historical episode during 1996 and a current 2000 episode yet to be determined. If an appropriate PM<sub>10</sub> episode does not occur during the winter of 2000, another 1996 historical episode will be modeled. Because there have been no violations of the PM<sub>10</sub> NAAQS since 1995, the historical episode does not represent excessive PM<sub>10</sub> concentrations. In addition, availability of PM<sub>10</sub> data is sparse in the 1990's due to relatively clean air quality during this time period. Since aerosol modeling is still in its infancy, relative to photochemical ozone modeling, guidance on model performance evaluation is not available. For this reason UAM-AERO may be used in a relative sense only. That is to say that the modeling results may be used to inform and supplement a method of speciated linear rollback, rather than use the model results in a traditional modeled attainment test.

The state of Utah is required to develop a plan to demonstrate that it is able to maintain ambient air quality conditions for PM<sub>10</sub> below the federal 24-hour standard for specific years in the future for the nonattainment area. To aid in meeting the goals of this study DAQ will seek contract support for 1) the development of the emissions inventory, 2) highly resolved prognostic meteorological fields, and 3) consulting for modeling analysis of both input and output data sets. DAQ will provide the modeling expertise for the general development and running of UAM-AERO through a multi-phased effort to apply an aerosol grid model to the Wasatch Front area.

To provide oversight, a Technical Review Panel (TRP) will be formed and retained throughout the effort. This TRP will be made up of representatives of a wide variety of entities that could be affected by, or would have a specific interest in, the application of UAM-AERO results; e.g., EPA, local government agencies, transportation, industry, environmental groups, MPOs, etc. Throughout this process briefings to the TRP are to be made by a combination of letter mailings, routine reports, and meetings at the DAQ office. These meetings will provide a forum for the DAQ modeling team to personally brief members of the DAQ staff and TRP members.

The modeling protocol documents the activities associated with conducting the PM<sub>10</sub> modeling and evaluating the model's performance prior to its use in emissions control strategy testing. A subsequent addendum to this protocol will be prepared, if needed, to provide more specific information on the methodologies for estimating control strategy requirements, procedures for attainment demonstration, and associated documentation and submittal requirements.

## Choice of Models

It is recommended that the UAM-AERO employing CB-IV chemistry be used as the aerosol model in the PM<sub>10</sub> SIP modeling. UAM-AERO is an extension of the widely used photochemical model, the Urban Airshed Model (UAM), Version IV, which has been adapted to treat aerosol processes. DAQ chose to use this model because of extensive staff experience using UAM-IV for ozone analysis and because the chemical mechanism in UAM-AERO has been tested more extensively than for other models (Seigneur and Pai, 1999). The key feature of the UAM-AERO model is that it provides a common framework in which to evaluate relationships between

ambient concentrations of both ozone and particulate matter (PM), and their precursor emissions. (Kumar and Lurmann, 1996; Lurmann, et al, 1997) Assistance with setup and evaluation of UAM-AERO will be obtained from an experienced contractor.

Given the complexity of the local mountainous terrain, in close proximity to two large bodies of water (Utah Lake and Great Salt Lake), DAQ recommends the use of a high-resolution prognostic meteorological model to develop the meteorological inputs to the UAM-AERO. Specifically, scientists at the University of Utah Department of Meteorology and NOAA Cooperative Institute for Regional Prediction will be responsible for developing meteorological input data for the UAM-AERO. This effort will involve running a prognostic mesoscale model – the Penn State/NCAR mesoscale model (MM5).

Processing of the emissions data sets assembled for point, area, and mobile sources will be accomplished through use of the Sparse Matrix Operator Kernel Emission (SMOKE) modeling system. This emissions handling system was developed by EPA for integration into the Models-3 Air Quality Modeling System. SMOKE outputs will need to be modified for input into UAM-AERO. Because winter time episodes will be modeled, estimates of biogenic emissions will not be included in the analysis. The emissions data sets will be created and evaluated by an experienced contractor in consultation with DAQ.

## **Overview of the Modeling Project**

Since the early 1990's there have not been any major inversion episodes (stagnant conditions persisting for one to three weeks) in the Wasatch Front urban area. It is during stagnant conditions that  $PM_{10}$  builds up in the area and as the condition persists, more and more  $PM_{10}$  (especially secondary PM) accumulates causing ambient values to exceed the NAAQS. One 5-day episode has been selected during February, 1996 as this episode has the highest ambient  $PM_{10}$  values during the most recent five year period. Although the meteorological database from 1996 is more limited than is currently available, there is a chemically speciated data set for some of the  $PM_{10}$  monitors on several of the episode days. In June, 1996 a wider network of meteorological observations became available, however, there have not been any candidate episodes to model since that time. DAQ plans to embark on intensive  $PM_{10}$  data collection during the winter of 1999-2000 in hopes of capturing a significant  $PM_{10}$  episode which can be modeled using current emissions and meteorological observations. If a significant  $PM_{10}$  episode does not occur during the winter of 1999-2000, then DAQ will model another February, 1996 episode.

Because of the limited  $PM_{10}$  and meteorological databases from February 1996, and the fact that  $PM_{10}$  values have not been significantly elevated over the past four years, DAQ is uncertain about its capability to model the  $PM_{10}$  phenomenon with a level of accuracy that one would like for using model results as the basis of regulatory policy. If the performance evaluation indicates that UAM-AERO results are not appropriate for regulatory decision-making, then DAQ will apply speciated rollback methods to proceed with SIP development. UAM-AERO results may be able to elucidate important  $PM_{10}$  source sectors which may assist in the speciated rollback evaluation.

**\*\* Complete protocol available at: <http://www.deq.state.ut.us/eqair/sip/pm10sip/modeling/mod-prot.pdf>**